December 22, 1859.

Sir BENJAMIN C. BRODIE, Bart., President, in the Chair.

Bennet Woodcroft, Esq., was admitted into the Society.

The following communications were read:—

I. "On the Electric Conducting Power of Alloys." By A. MATTHIESSEN, PH.D. Communicated by Prof. WHEATSTONE. Received November 17, 1859.

(Abstract.)

In this paper I have given the determinations of the electric conducting power of upwards of 200 alloys, and have found that the metals employed may be divided into two classes, viz.—

A. Those metals which, when alloyed with each other, conduct electricity in the ratio of their relative volumes.

B. Those metals which, when alloyed with one of class A, or with each other, *do not* conduct electricity in the ratio of their relative volumes, but *always less*.

The alloys may be divided into three groups; viz.—

1. Those made of the metals of class A with each other.

2. Those made of the metals of class A with those of class B.

3. Those made of the metals of class B with each other.

From the experiments described in the paper I have tried to deduce the nature of alloys, and have arrived at the following conclusions:—

A. That most alloys are only a solution of one metal in the other; for,—

1. On looking at the curves belonging to the different groups, we see that each group of alloys has a curve of a distinct and separate form. Thus for the first we have nearly straight lines; for the second, the conducting power decreases always rapidly on the side of the metal belonging to class B, and then turning, goes almost in a straight line to the metal belonging to class A; for the third group we find a rapid decrement on both sides of the curve, and the turning-points united by almost a straight line.

2. On examining that part of the curve where the rapid decrement takes place, we find that with the lead and tin alloys it generally requires twice as many volumes of the former as of the latter to reduce a metal of class B to a certain conducting power.

3. That the turning-points of these curves are not chemical combinations we may assume from the fact that they only contain very small per-centages of the one metal.

4. That the alloys at the turning-points have their calculated specific gravities.

5. From the similarity of the curves of the conducting power of alloys, where we may assume we have only a solution of one metal in the other, we may always draw approximatively the curve of the alloys of any two metals if we know to which class they belong.

B. That some alloys are chemical combinations; for—

1. At the turning-points of the curve we generally find contraction or expansion.

2. We have no regular form of curve, so that we cannot *a priori* approximatively draw it.

3. At the turning-points of the curve, the alloy retains large per-centages of each metal.

4. The appearance (crystalline form, &c.) of the alloys at these points is different from each other.

C. That some alloys are only mechanical mixtures; for example, bismuth-zinc, lead-zinc, some silver-copper alloys, &c.

The question now arises, To what is the rapid decrement of the conducting power of the metals belonging to class B, when alloyed with other metals, due?

The only answer I can at present give to this question is, that most of their other physical properties are altered in a like manner; for where we find no marked change in most of the physical properties, as in group I, and in the second group on the one side of the curve, then we have nearly their calculated conducting powers.

In the Appendix I have given some determinations of the conducting power of pure gold, which I find has a higher value than that generally quoted.

In conclusion, I may take this opportunity of thanking Dr. M. Holzmann for the excellent manner in which he has carried out the greater part of the experiments.